

WFIRST Photo-z Requirements and Calibration Needs

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Current Requirement

HLIS 5: Photo-z error distribution width $\leq 0.04(1+z)$, catastrophic error rate $< 2\%$

HLIS 6: Systematic error in photo-z offsets $\leq 0.002(1+z)$

Residual requirements from SNAP, have not been reexamined in light of recent work on photo-zs, better understanding of mock galaxy catalogs, and flowdown of errors

Reexamination of this requirement led to refining mock catalogs and neff drop from ~ 60 to 50

The Problem

WFIRST study assumes:

$\sigma_{\text{dz}} = \text{dz}/(1+z) < 0.04$ at $z < 2$

Outlier fraction $< 4\%$ for the lensing sample defined as $H < 24.7$

Bias of $0.002/(1+z)$ in the photo-z

WFIRST supplied photometry in four bands between 0.8-2 μm

The photo-z accuracy is determined by the signal-to-noise across the 4000Å break for optical photo-z (Wolf et al. 2004, Ilbert et al. 2009, see Figure 1). Scaling from existing surveys (COSMOS, GOODS-N, CANDELS, etc), we will require a SNR of > 20 for the lensing sample to reach a $\text{dz}/(1+z) < 0.04$

Conclusions

Galaxies are $\sim 1-4$ mags fainter in the optical than the H. Reaching $\text{SNR} \sim 20$ on the 4000Å break would require 29 in g and 28.5 in I, requiring all LSST time dedicated to the WFIRST survey.

Must go deeper in WFIRST (so more galaxies can be rejected) or must change requirement to allow some fraction of galaxies to have worse photo-z

Alternative Method of Writing Requirement

Need to be more clever about writing requirements

Newman “suggest[s] defining the error distribution as the sum of (hopefully only 2) Gaussians or other simple functions — one to describe the core and the other outliers”; this formalism would be straightforward to carry through to FoM

Capak :

$z > dz/(1+z) <$	Fraction of sample
-0.2	x%
-0.03	x%
0.03	x%
0.2	x%
∞	x%

where the X's are defined by the distributions I sent out + some margin of error, or alternatively something like SMOS that is similar in depth to the LSST survey.

Draft Euclid requirement: A probabilistic galaxy redshift distribution (PDF(z)) shall be derivable for each galaxy. In each sub-set (bin) used for the weak lensing analysis in the range $0.2 < z < 2.0$ (TBD) the average of the mean-subtracted PDF(z) ($\text{PDF}(z) - \text{mean}[\text{PDF}(z)]$) shall meet the following cumulative probability requirements:

$\int \text{Mean}(z) - \text{PDF}(z) / (1+z)$	Fraction of probability
	68%
	90%

Not mutually exclusive, and we are narrowing in on an acceptable definition to iterate on requirements

Work Plan

Revise requirements (Capak and Newman working on this)

- Systematic
- Statistical

Flow down to FoM (Hirata/Weinberg)

Iterate

Leave room for uncertainty and evolution in understanding of IA, which is rapidly evolving

Let LSST know about potential requirements and request for cadence change

Calibration Data

Ongoing work for Euclid (Capak) and LSST (Newman) [and many others] suggests that the number of spectra needed to calibrate photo-zs is up to 100,000 in a complete sample down to the limits of the survey

This is very difficult given WFIRST depths

Factors of 2-10 reduction in this number (per bin) may be possible

Spectra will come from HLS, IFU (WFIRST), ground campaigns, JWST, 30-meter class telescopes

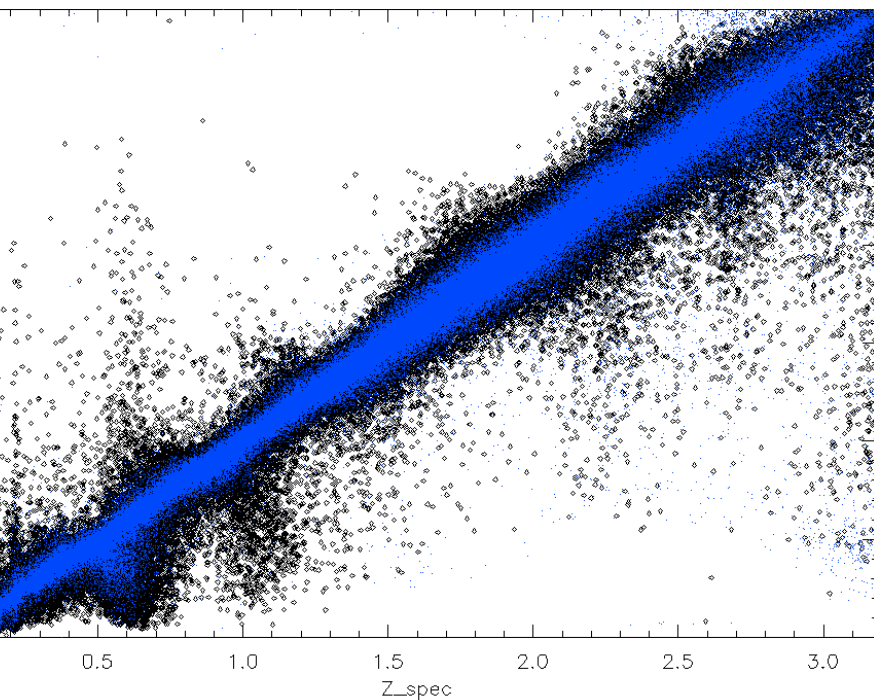
Euclid 'answer' expected in next year or so, and will inform ongoing WFIRST work and requirements

CASTOR: the Cosmological Advanced Survey Telescope for Optical and Ultraviolet Research

Proposed Canadian UV telescope

One goal might be to improve WFIRST photo-z

Ongoing discussions with CASTOR team and SDT
member Hudson



Black: WFIRST/LSST
Blue: W/ CASTOR

Plots by Dan
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